A3-277
METROLOGY
LABORATORY

Rutherford

ELECTRONICS CO.

A-3 272
METROLOGY
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TIME DELAY GENERATOR MODEL A2 and A4

8944 LINDBLADE ST.,
CULVER CITY,
CALIFORNIA

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TIME DELAY GENERATOR

MODEL A2
&
MODEL A4

Serial No. 159

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Price $5.00

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ELECTRONICS CO.
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TELEPHONE UPton 0-7393

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This instruction manual is for use with the RUTHERFORD TIME DELAY GENERATORS, Model A2 and A4. It should be understood that the entire manual pertains to both instruments. Where differences occur between the instruments, they are so indicated throughout the text.

TIME DELAY GENERATOR

MODEL A2 & MODEL A4

GENERAL DESCRIPTION

The RUTHERFORD Model A2 and Model A4 TIME DELAY GENERATORS are general purpose precision instruments whose function it is to produce continuously variable delayed pulse signals.

The instruments are capable of operating over extremely wide ranges of time delay with accuracies relatively unaffected by line voltage or duty factor. The Model A2 produces delays from 0.8μseconds to 100,000μseconds and the Model A4 produces delays from 10μseconds to 10 seconds, each in 5 ranges.

The use of precision components in critical circuits insures quality performance.

The time delay may be adjusted by means of a dial or by an external voltage.

SPECIFICATIONS

INTERNAL OSCILLATOR RANGES (MODEL A4 ONLY)

1,000 cycles/sec. - 100 cycles/sec.
100 cycles/sec. - 10 cycles/sec.
10 cycles/sec. - 1 cycle/sec.
1 cycle/sec. - 0.1 cycle/sec.

DELAY RANGES

(MODEL A2 ONLY)

0.8μsec. to 10μsec.
100 μsec.
1,000 μsec.
10,000μsec.
100,000 μsec.

(MODEL A4 ONLY)

0.00001 sec. to 0.001 sec.
0.01 sec.
0.1 sec.
1 sec.
10 sec.

INCREMENTAL DELAY - Limited by the resolution of the helical potentiometer control to 1/13,500 of full scale.

JITTER - 0.01μsec. or 0.008%, whichever is greater.

ACCURACY

AFTER CALIBRATION	±0.1% of full scale.
LONG TERM	±1% of full scale.

LINEARITY - ±0.3% or better between 0.1 full scale and full scale (except 0.8 to 10μsec. range of the Model A2).

OUTPUT PULSES

BLOCKING OSCILLATOR (TRIGGERED)

Width - 0.5μsec. wide between 10% points, APPROX
Rise Time - 0.1μsec. between 10% and 90% points.
Output Impedance - 100Ω (0.01μF blocking condenser).
Amplitude - more than 50 volts, OPEN-CIRCUITED

MULTIVIBRATOR

Width approximately as per table below. For presentation on synchroscope.

(MODEL A2 ONLY)

RANGE	WIDTH
10μsec.	5μsec.
100μsec.	10μsec.
1,000μsec.	30μsec.
10,000μsec.	100μsec.
100,000μsec.	400μsec.

(MODEL A4 ONLY)

RANGE	WIDTH
0.001 sec.	30μsec.
0.01 sec.	100μsec.
0.1 sec.	500μsec.
1 sec.	5,000μsec.
10 sec.	50,000μsec.

Output Impedance - 500Ω (0.1μF blocking condenser).
Amplitude - 35 volts, OPEN-CIRCUITED

SYNCHRONIZING PULSE (MODEL A4 ONLY)

Width - 0.5μsec.
Rise Time - 0.1μsec. between 10% and 90% points.
Output Impedance - 100Ω.
Amplitude - more than 50 volts.

EXTERNAL DELAY VOLTAGE - 150 to 50 volts for 0 to full delay.

REPETITION RATE EFFECTS - The error introduced by repetition rate changes is a function of the percent duty factor. A representative table of duty factor effects for 1,000μsec. scale is shown below.

DUTY FACTOR	ERROR
0.5%	0.0% (Reference)
5%	0.1%
50%	0.4%
90%	3.2%
95%	5.0%
97%	5.5%

NOTE: The duty factor must be limited to allow at least 3μsec. recovery time.

EFFECT OF LINE VOLTAGE VARIATIONS - Variations from 105 volts to 125 volts changes the delay by 0.15%

DIAL CALIBRATION - 1000 divisions, each approximately 1/8 inch wide.

INPUT TRIGGER REQUIREMENTS

AMPLITUDE - A 15 to 60 volt pulse, or,
A 30 to 60 volt, RMS, 100 cycle sine wave.
BLOCKING CONDENSER - for 400 volts.
IMPEDANCE - 20μμF and 470,000Ω.

INDICATOR TUBE - "Magic Eye" tube type 6E5 to indicate coincidence of delayed pulse and calibrating pulse.

TUBE COMPLEMENT

1ea. 0A2	1ea. 6AU6	3ea. 12AU7
1ea. 6AL5	1ea. 6E5	2ea. 12AX7
2ea. 6AS5	2ea. 6X4	1ea. 5651
2ea. 6AS6	4ea. 12AT7	1ea. 5694

(6ea. 12AT7 in Model A4 only.)

CONNECTORS

INPUTS AND OUTPUTS - S0239 (Video type) (May be fitted with UG-273/U adapters for BNC connectors).

POWER - 105-125 volts, 50-60 cycles per second, 160 watts.

WEIGHT - 47 lbs.

ACCESSORIES INCLUDED - 1 ea. Instruction Manual

OPERATING INSTRUCTIONS

PRELIMINARY INSTRUCTIONS

VENTILATION - To prevent excessive interior temperatures, it is important to allow adequate ventilation for the TIME DELAY GENERATOR. Several inches clearance should be provided at the sides, back, and top of the case.

HANDLING - Although the components are well supported and the adjustments stable in setting, the TIME DELAY GENERATOR should not be subjected to excessive vibration or rough handling.

DUTY FACTOR LIMITATION - Do not attempt to operate at more than 100% duty factor. The time delay must, at all times, be less than the time between trigger pulses.

FRONT PANEL CONTROLS

COINCIDENCE INDICATOR - A type 6E5 "Magic Eye" tube which opens when the internally delayed pulse is in coincidence with an external pulse introduced into the calibrate input connector.

DELAY - Sets the significant figures on the delay time.

FUSE - A 2 ampere fuse to protect the equipment from damage due to short circuits.

BLOWN - Indicates when fuse is blown.

TRIGGER (+) or (-) - Provides for either positive or negative input triggers.

CALIBRATE IN - Input connector for external pulse to coincidence detector and indicator.

DELAYED PULSE OUTPUT

Blocking Oscillator - Short output pulse from low impedance blocking oscillator.
Multivibrator - Long output pulse from cathode follower. Generated by multivibrator whose width is a function of the delay range in use. For synchroscope presentation.

PILOT - Indicates that unit is "ON".

ON-OFF - Controls all power to the unit.

DELAY VOLTAGE IN - Input to pickoff circuit con-

trolling time delay. The delay of the unit will be a linear function of the voltage between the range of approximately 50 volts and 150 volts with the higher voltage corresponding to the shorter delay.

INT.-EXT. - Connects the input to the pickoff circuit controlling the delay to either the helical potentiometer or to the delay voltage in jack on the front panel. Normally it is used in the internal position.

(MODEL A2 ONLY)

DELAY RANGE - MICROSECONDS - Sets the maximum delay of the delay scale. Determines the decimal point in the significant figures selected by the delay control.

TRIGGER IN - Input connector for triggering the unit from an external source.

(MODEL A4 ONLY)

DELAY RANGE - SECONDS - Sets the maximum delay of the delay scale. Determines the decimal point in the significant figures selected by the delay control.

TRIGGER IN-OUT - Input connector for initiating triggers, or output of synchronizing pulse at zero time.

REPETITION RATE - Sets the significant figures of the internal repetition rate oscillator in cycles per second.

REPETITION RATE RANGE - Determines the decimal point in the significant figures selected by the repetition rate dial in cycles per second.

FIRST TIME OPERATION

To place the TIME DELAY GENERATOR in operation for the first time, the following procedure is suggested.

1. Connect to a source of 105-125 volt, 50-60 cycle power.

2. Set controls as indicated below.

DELAY	500
DELAY RANGE	(A2) 100μsec. (A4) 0.001 sec.
TRIGGER	Positive
ON-OFF	On
INTERNAL-EXTERNAL	Internal (IMPORTANT)

3. Connect a positive trigger of approximately 25 volts amplitude to the trigger input connector on the front panel. The repetition rate of this signal should be 2,000 cycles per second (500μsec. pulse spacing) for the Model A2, and 200 cycles per second (5,000μsec. pulse spacing) for the Model A4.

4. Connect the synchronizing signal input of a synchroscope to the trigger source and adjust the synchroscope for externally triggered operation. Select a 100μsec. sweep for the Model A2 and for the Model A4, a 1,000μsec. sweep.

5. Connect the DELAYED PULSE OUTPUT - MULTIVIBRATOR to the signal input of the synchroscope. The output pulse should now be visible on the synchroscope at the 50μsec. point if the Model A2 is being operated, or at the 500μsec. point if the Model A4 is used.

The delay will become stabilized after a thirty (30) minute warmup period.

NOTE: If the output pulse is not there, the following may be wrong.

1. The instrument may be operating at more than a 100% duty factor.

2. The input pulse amplitude may not be between the limits of 15 to 60 volts.

3. The front panel switch delay voltage control may be switched to "External".

4. The front panel trigger ± switch may be incorrectly set.

OPERATION

To operate the TIME DELAY GENERATOR at other delays, proceed as follows:

1. Connect signals as outlined above.

2. Select the delay range required. This is the maximum delay available on the delay dial. The 1,000 mark on the delay dial will correspond to the maximum delay of the range selected.

3. Set the delay required on the delay dial, keeping in mind that if the dial reading is less than 100, better results will be achieved by turning to the next lower delay range.

4. To use the coincidence indicator, connect a lead carrying the pulse whose coincidence is to be indicated to the COINCIDENCE INPUT connector on the front panel. It should be noted that the repetition rate of the pulse whose coincidence is to be detected should be equal to or a multiple of the repetition rate of the delayed pulse. Slowly rotate the delay control dial until the coincidence indicator opens. Since indication is exceptionally sharp, it is helpful to examine the relative positions of the two pulses by means of a synchroscope. This will permit hunting with the dial over a small scale length rather than the entire 1,000 divisions.

It will be noted that the "Magic Eye" does not close immediately after the coincidence pulses are moved out of coincidence, but with a considerable time

constant. This represents a design compromise between coincidences at high and low repetition rates. At low repetition rates, the condenser in the grid of V20 at pin 7 must store sufficient energy to operate the "Magic Eye" tube between coincidences. At high repetition rates, if this characteristic is annoying, one or two of the 22 megohm resistors connected in the plate of V20 at pin 1 can be shorted out, giving a shorter time constant.

CALIBRATING INSTRUCTIONS

The TIME DELAY GENERATOR may be calibrated from any suitable pulse source.

Connect trigger and coincidence voltages to the respective inputs, remembering that the coincidence or calibrating voltage must have a repetition rate greater than the triggering pulse and must be a multiple of the triggering pulse rate. The calibrating pulse repetition rate must be selected so that 10 pulses occur during the delay range to be calibrated if dial calibrations at the points 100 and 900 are required. For other calibrating points, the user may calculate appropriate repetition rates.

Adjust the delay dial to the 100 setting. Then rotate the upper calibrating potentiometer for the range under consideration (located in the rear of the panel) so that the delayed pulse moves from large delay to small delay. Continue the adjustment of the upper calibrating potentiometer until coincidence is just detected, which is indicated by opening of the "Magic Eye" indicator. Then set the delay dial to 900 and adjust the lower calibrating potentiometer, moving the delayed pulse from large delay to small delay until coincidence is just detected. Return to the 100 setting of the delay dial and repeat the process. Then again to the 900 setting and repeat.

This is a converging process, and after several repetitions the delay range will be calibrated. This calibration must be performed for all five delay ranges in the unit. After each delay range has been calibrated, tighten the shaft locking nuts on the calibration potentiometers and again check the calibration to make sure that it has not been disturbed when the potentiometer shafts were locked.

Check the delay at other points on the dial to insure that the correct calibration points have been selected. Check the delay with a synchroscope to insure that the range is 0 to 1,000 and not 100 to 1100.

The instrument was calibrated as shown below.

(MODEL A2 ONLY)

DELAY RANGE (μsec.)	REPETITION PERIOD (μsecs. between pulses)	CALIBRATION PULSE SPACING (μsecs. between pulses)
10	500	
100	500	10
1000	2000	100
10,000	20,000	1000
100,000	200,000	10,000

(MODEL A4 ONLY)

DELAY RANGE (sec.)	REPETITION PERIOD (secs. between pulses)	CALIBRATION PULSE SPACING (secs. between pulses)
0.001	0.002	0.0001
0.01	0.02	0.001
0.1	0.2	0.01
1	2	0.1
10	20	1

ADJUSTMENTS

SENSITIVITY OF THE "MAGIC EYE" INDICATOR - This potentiometer is located on top of the chassis between V20 and V7. The exact adjustment may be a matter of the preference of the user, depending upon which scale is used. The recommended adjustment is for maximum sensitivity without false indications when operated at high repetition rate.

MULTIVIBRATOR OUTPUT PULSE WIDTH - Adjustable by means of a potentiometer located on the top of the chassis in front of V12.

CIRCUIT DESCRIPTION

The basic circuit of the TIME DELAY GENERATOR is a negative triangle generator with various capacitors inserted in the grid circuit to give variable slopes of the triangular waveform. The time delay is controlled by varying the voltage at which the pickoff tube operates. Associated with this circuit are various supplementary circuits which enhance the operation.

The input circuit to the TIME DELAY GENERATOR consists of an amplifier from which outputs may be taken either in phase or inverted in phase so as to permit the TIME DELAY GENERATOR to operate from either positive or negative input triggers. The output of this amplifier is connected to a Schmidt trigger circuit to permit positive operation of the succeeding circuits from slowly rising wave fronts.

The Schmidt trigger circuit operates when the input signal crosses the grid base of section A of this tube. The sensitivity is determined by the negative bias on the grid of the tube. To render the circuit more sensitive, the grid should be reduced. The circuit requires approximately 15 volts peak trigger voltage.

The output is differentiated to produce short negative pulses which operate the bistable flip-flop circuit, V3. When V3 changes states, it applies a positive bias to the sup-

pressor grid of the triangle generator tubes, V5 and V6. The positive gate applied to the suppressor grids of these tubes starts the generation of a negative going triangular wave at their plates. Two type 6AS6 tubes are connected in parallel to give an increased transconductance to charge the stray capacity in the circuit and hence increase the slope of the initial step of the triangular waveform when extremely short time intervals are to be generated. A cathode follower, V7, is employed to charge the condensers in the timing network. The use of this cathode follower results in fast recovery and hence operation at high duty factors.

V4 is a clamping diode, one half of which establishes the starting point of the triangle and the other half clamps the suppressor grid voltage.

V8 is a trigger type pick-off tube which generates an output pulse when the voltage at the grid of the first section becomes approximately equal to the voltage at the grid of the second section. The voltage on the grid of the second section is determined by a precision helical potentiometer. Fixed resistors and factory adjusted potentiometers are placed at each end of the helical potentiometer to adjust the zero and full scale points on each range to correspond to the dial readings. These fixed resistors are switched into the circuit by means of the range switch. The range switch also changes the capacitors and resistors in the timing network which are located in a thermostatically controlled oven to eliminate temperature effects.

The pulse from the pickoff circuit is amplified and triggers a blocking oscillator. The pulse from the blocking oscillator is one of the outputs from the delay generator. The blocking oscillator also triggers a multivibrator which provides an output pulse whose width is equal to one to five percent of the delay range in use. The multivibrator width may be changed over a limited range by adjusting a potentiometer in its grid circuit.

The blocking oscillator pulse is used to re-set the bi-stable circuit, V3. This terminates the positive voltage applied to the suppressor grid of the triangle generator tube and causes the plate waveform to return to the clamp voltage. V7 then immediately recharges the timing capacitors and the circuit is ready to generate another triangular waveform.

To improve the operation of the triangle generator, it is necessary that the starting voltage of the negative triangle be definitely established. This cannot be properly done by means of resistor divider networks since the diode, V4, would draw current dependent upon the cathode of this diode at a stable potential, an auxiliary power supply is used which maintains the potential of V4 fixed with respect to ground regardless of the repetition rate of the unit.

To assist in the calibration of the TIME DELAY GENERATOR by means of a calibrator providing pulses at known time intermals, a gated detector is incorporated. This gated detector provides a voltage which causes the "Magic Eye" to open when the delayed pulse is in coincidence with a pulse coming into the calibrator input of the TIME DELAY GENERATOR.

The power supplies in this unit are of conventional type. The positive supply employs full wave rectifiers together with an electronic regulator circuit. The negative employs a half wave selenium rectifier and gas discharge tube voltage stabilizer. A voltage regulator tube is used to provide the negative bias voltage to the unit, and a voltage reference tube is used to provide the reference voltage for the voltage regulator circuits.

Filament currents on selected tubes are stabilized to prevent changes of their characteristics due to changes in filament emission. Two Amperite 10-4B current regulator tubes are used to perform this function.

(MODEL A4 ONLY)

The Model A4 provides a pulse source as the reference pulse in addition to a pulse which may be varied in time from 10 microseconds to 10 seconds with respect to this reference pulse.

A multivibrator is used as the internal oscillator with the grid leak resistor returned to a variable voltage providing a continuously variable frequency control. Range switching is provided by the switching of the two cross coupling capacitors.

It should be noted that the repetition rate dial and ranges are calibrated in cycles per second, NOT in time as is the timing of the delayed pulse.

The output from the multivibrator is differentiated and the positive going edge triggers a blocking oscillator. The positive pulse from the blocking oscillator cathode is brought out as the synchronizing pulse. Its width is approximately 0.5μsec.

MAINTENANCE

REMOVAL OF THE CASE - The instrument may be removed from its protective case by removing the four (4) screws at the right and left hand sides of the front panel, which hold the panel to the case, and by removing the two (2) screws in the lower rear of the case, which fasten to the rear of the chassis. DO NOT attempt to force the instrument back into the case.

IMPORTANT: Do not forget to replace the rear screws when reassembling the unit, as they support the rear of the chassis.

TROUBLE SHOOTING

A systematic procedure for locating trouble is advisable. The following is suggested after inspection has been made for gross flaws such as

a blown fuse, burned out tubes, burned out resistors, etc.

MEASURE VOLTAGES:

+250V	pin 1	V15	red lead
+180V	pin 8	V7	orange lead
-150V	pin 2	V18	green lead
- 85V	pin 2	V19	

Comparator voltage from Helipot at Helipot side of 47K resistor connected to pin 7, V8 should vary from approximately +55 to +150 volts with Helipot dial setting.

The filament voltages furnished by the 10-4B regulators should be greater than 6 volts. Low voltage indicates weak 10-4B tubes, which should be replaced. Sagging filament wires in the 10-4B tubes is a sign of old age, and the voltage should be measured between pins 6 and 7 on the 10-4B tubes.

Trace a signal through the circuit with a synchroscope, referring to the waveforms shown.

1. Phase Inverter, V1A. Plus-minus switch should be positioned to give a positive pulse on grid 2 of V2.

2. Trigger Circuit, V2. If input pulse is shorter than 4 microseconds, plate 1 will show a negative pulse 4 microseconds wide. If input is longer than a 4 microsecond pulse, plate 1 will be negative for the length of time that grid #2 is above cutoff.

3. Flip-flop Circuit, V3. Plate #1 normally conducts. Input pulse cuts off plate #1 and pulse from V1B resets the circuit. If the waveform on plate #1 is a square wave of period equal to twice the repetition period, the reset pulse is not operating.

4. Triangle Generator. The waveform on the plate of the triangle generator is indicative of its correct operation. There should be a small sudden drop followed by the Miller rundown of the triangle. If the triangle is not correct, there are two chief sources of trouble.

   A. The transconductance of the 6AS6 tubes may be low. This is indicated by the waveform on the grid, pin #1. The trailing edge should have a positive jump of several volts. If there is a very small positive jump or none at all at the point where the triangle ends, the 6AS6 tubes are worn out. The transconductance is so low that the grid must go to zero bias to pull the plate voltage down to the required value.

   B. The bias network on the suppressor grid of the 6AS6 tubes may have changed slightly in value. This gives rise to several triangular waveforms occurring in one repetition interval. The cure is to reduce the value of the 1.3 megohm (nominal value) resistor in the suppressor grid circuit between the suppressor grid and -150 volts.

5. Comparator Circuit, V8. If this waveform appears on plate #6 of V8, the 1mH choke coil is open circuited. This waveform indicates that the 1N51 is open circuited or that the forward resistance is high. The correct waveform is

6. Blocking oscillator, V11A. The blocking oscillator may fail to operate because components have aged and increased the bias on grid #2 of V11A.

7. Coincidence Indicator, V20, V21. The chief cause of trouble will be the aging of components and changes in bias on the grids of tubes. Since several stages of D.C. amplification are employed, they should be checked.

In all the foregoing circuits it is recommended that a new tube be the first change tried.

NOTE: The delay calibration is dependent on the characteristics of some of the tubes employed. These change rapidly during the first 50 hours of operation, and it is suggested that the unit be operated for this time after tubes V4, V5, V6, V7, V8, or V9 are changed before precise calibration be attempted. A 1% drift may be encountered in the first hours of operation. Experience has indicated that tubes most likely to fail are V5, V6, and V8.

POWER SUPPLY CHECK

All voltages with respect to ground and all voltages are DC unless otherwise specified.

TUBE	TUBE SOCKET	PIN #	VOLTAGE
0A2	V18	2	- 150 Volts
		5	Ground
5651	V19	2	-85 Volts
		5	Ground
6X4	V13&V14	1	360 Volts, AC
		6	360 Volts, AC
		7	415 Volts, Unregulated
6AS5	V15&V16	7	415 Volts, Unregulated but filtered
		6	415 Vlots, Unregulated but filtered
		2	225 Volts, Regulated
		1	250 Volts
6AU6	V17	5	Same as pin 2, V15&V16
		2&7	Ground
		6	137 Volts
		1	-4.7 Volts

12AU7	V7B	6	250 Volts, Regulated	12AX7	V9B	6	172 Volts
		7	177 Volts			7	-2 Volts
		8	180 Volts			8	Ground

REPLACEMENT OF COMPONENTS

In the event that component replacement becomes necessary, it is strongly recommended, in order to avoid considerable delay and unnecessary expense, that such replacement components be purchased from your local electronics supplier. A large majority of the components used in the instrument are standard electronic components and little difficulty should be encountered in replacing them.

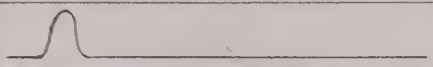
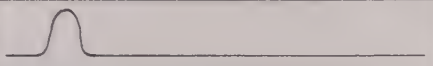
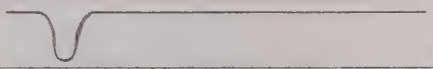
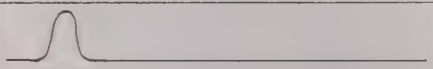
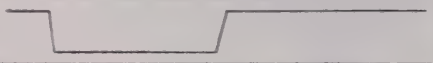
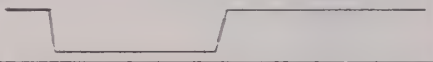
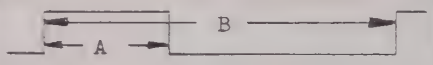
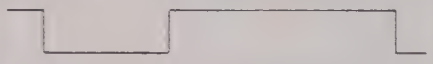
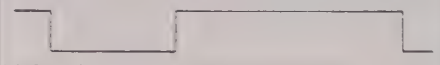
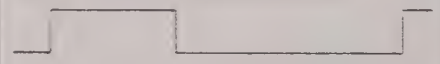
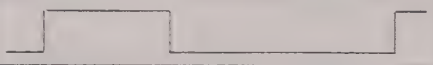
Certain components, manufactured to RUTHERFORD ELECTRONICS CO.'S specifications, may not be readily available through local suppliers. These components should be ordered from our factory.

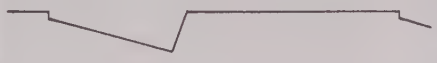
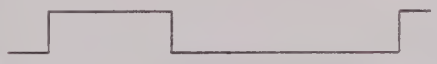
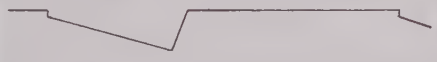
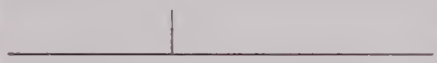
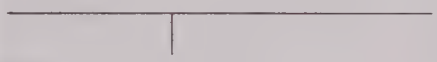
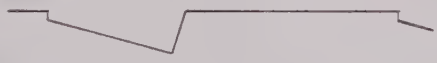
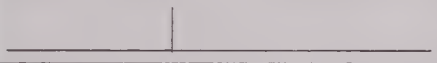
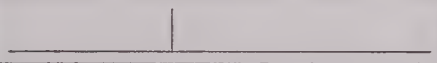
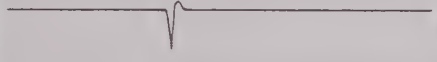
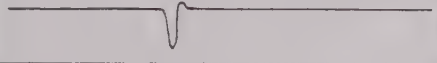
WARRANTY

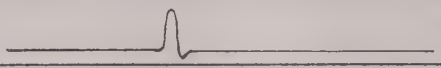
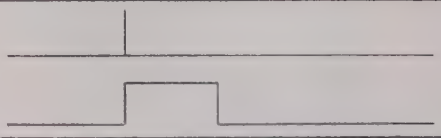
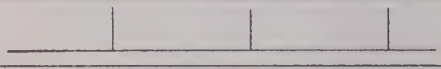
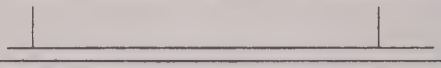
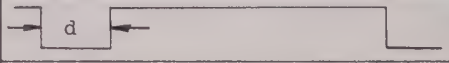
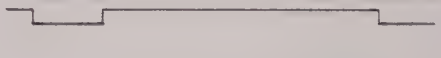
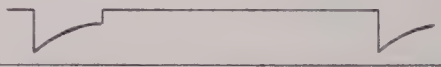
RUTHERFORD ELECTRONICS CO. guarantees to the original purchaser for a period of one (1) year, EXCEPT vacuum tubes which are guaranteed for ninety (90) days, that this instrument is free from defects in material and workmanship. Our liability is limited to repair or replacement of this instrument, or any part thereof, providing failure is not due to misuse or abnormal conditions.

In order to receive service under this warranty, promptly advise the factory of all details pertinent to failure of the instrument. Replacement parts will be shipped via air transportation if requested, prepaid to any point in the continental United States. Should it be desirable to return the instrument, ship it prepaid to the factory, and it will be serviced as required and returned via surface transportation, prepaid.

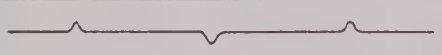
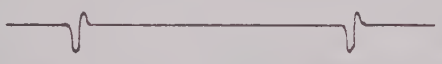
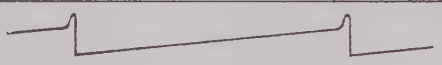
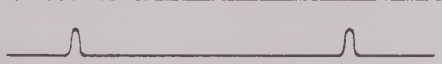
Service required after the expiration of warranty, or because of misuse or abnormal conditions will be billed at cost.

TUBE TYPE	TUBE SOCKET	PIN #	WAVEFORM OR VOLTAGE	REMARKS
12AT7	V1 PHASE INVERTER	2		Typical triggering waveform
		3		Same waveform as pin #2, V1
		1		Negative of pin #2, V1
		4,5, &9		Filaments
12AT7	V2 SCHMITT TRIGGER CIRCUIT	2		Same waveform as pin #3, V1 (Will always be a positive going waveform)
		3&8		"A" depends on trigger waveform with a minimum of about 3 or 4 μsec.
		1		
		7		Practically the same as pin #1, V2
		6		
		4,5, &9		Filaments
5964	V3 FLIP-FLOP	1		"A" depends on Helipot and range switch. "B" depends on rep. rate.
		2		Opposite in phase to pin #1, V3
		6		Same waveform as pin #2, V3, only smaller in amplitude.
		5		Same waveform as pin #1, V3
		7		No waveform. VDC
		3&4		Filaments
6AS6	V5 & V6 TRIANGLE GENERATOR	7		Same waveform as pin #1, V3. Small amplitude
		5		Amplitude at full range approximately equal to 100 volts.
		1		Small amplitude on grid
		6		Screen waveform
		2		Ground
		3&4		Filaments

TUBE TYPE	TUBE SOCKET	PIN #	WAVEFORM OR VOLTAGE	REMARKS
6AL5	V4 CLAMP TUBE FOR TRIANGLE GENERATOR	1		+180 Volts, DC
		7		Same as pin #5, V5 and V6
		2		Same as pin #7, V5 and V6
		3&4		Filaments
12AU7	V7A CATHODE FOLLOWER FOR TRIANGLE GENERATOR	1		+250 Volts, DC
		2		Same as pin #5, V5 and V6
		3		Waveform same as pin #5, V5 and V6
12AX7	V8 COMPARATOR	2		Waveform same as pin #5, V5 and V6
		3&8		Waveform same as pin #5, V5 and V6
		1&7		Pulse which moves as Helipot dial is moved.
		6		Pulse which moves as Helipot dial is moved.
12AX7	V9 COMPARATOR CONSTANT CURRENT TUBE	1		Waveform same as pin #5, V5 and V6
		2		Ground
		3		No Waveform
12AT7	V10 TRIGGER SHAPING AMPLIFIER	2		Same as pin #6, V8
		1		Amplified waveform of pin #6, V8
		3&8		Ground
		7		Same as pin #1, V10
		6		Blocking oscillator plate waveform
12AU7	V11 BLOCKING OSCILLATOR	1		Same as pin #6, V10
		2		Blocking oscillator grid
		3		Blocking oscillator or output pulse

TUBE TYPE	TUBE SOCKET	PIN #	WAVEFORM OR VOLTAGE	REMARKS
12AT7	V1B TRIGGER TUBE FOR FLIP-FLOP	7		Same as pin #2, V11
		8		Ground
		6		Same as pin #1, V3
12AT7	V20 COINCIDENCE STAGE FOR CALIBRATION	1		Blocking oscillator delayed pulse on range switch positions 10, 10^2, 10^3 Multivibrator delayed pulse on range switch positions 10^4 and 10^5
		2		Calibration signal waveform
		3		Ground
		7		Integrated coincidence signal
		6		DC amplifier
		8		Ground
6E5	V21 COINCIDENCE INDICATOR	3		-12 Volts, DC
12AT7	V12 MONOSTABLE MULTIVIBRATOR	2		Blocking oscillator pulse
		1		"d" depends on range switch position
		3&8		Smaller amplitude than pin#1, V12
		7		
		6		
12AU7	V11B CATHODE FOLLOWER	6		+250 Volts, DC
		7		Waveform same as pin #6, V12
		8		Waveform same as pin #6, V12. Output pulse

NOTE: The waveforms noted above are applicable to both the model A2 and the model A4. The following waveforms will be found only in the model A4.

TUBE TYPE	TUBE SOCKET	PIN #	WAVEFORM OR VOLTAGE	REMARKS
12AU7	V23 REP. RATE MULTIVIBRATOR	1		"t" depends on repetition rate switch and repetition rate range dial.
		6		
		7		
		2		
		3&8		Ground
12AT7	V22 REP. RATE BLOCKING OSCILLATOR	2		Differential multivibrator pulses
		1&6		Blocking oscillator pulses
		7		
		8		
		3		Ground

PARTS LIST

ABBREVIATIONS

cer	ceramic	k	kilohm or 10^3 ohms	PMC	paper, metal cased
comp	composition	m	milli or 10^{-3}	PT	paper tubular
EMC	electrolytic, metal cased	meg	megohm or 10^6 ohms	SM	silvered mica
EMT	electrolytic, metal tubular	MF	metal film	V	working volts, DC
f	farad	μ	micro or 10^{-6}	var	variable
GMV	guaranteed minimum value	μμ	micromicro or 10^{-12}	W	watt
h		Ω	ohm	WW	wire wound
		prec	precision		

CAPACITORS

C10	.1 μf	fixed	PT	400V	±20%
C20	.1 μf	fixed	PT	400V	±20%
C21	47μμf	fixed	cer	500V	±10%
C30	.1 μf	fixed	PT	400V	±20%
C31	47μμf	fixed	cer	500V	±10%
C32	47μμf	fixed	cer	500V	±10%
C33	.1 μf	fixed	PT	400V	±20%
C50	47μμf	fixed	cer	500V	±10%

(MODEL A2 ONLY)

C60	3-12μμf	var	cer	500V	
C61	15μμf	fixed	SM	500V	± 5%
C62	240μμf	fixed	SM	500V	± 5%
C63	1000μμf	fixed	SM	500V	± 5%
C64	.01 μf	fixed	SM	500V	± 5%
C65	.1 μf	fixed	mylar	200V	± 5%

(MODEL A4 ONLY)

C60	NOT USED				
C61	100μμf	fixed	SM	500V	± 5%
C62	1000μμf	fixed	SM	500V	± 5%
C63	.01 μf	fixed	SM	500V	± 5%
C64	.1 μf	fixed	mylar	200V	± 5%
C65	2ea. .5 μf in parallel	fixed	MP	300V	±10%
C70	.25 μf	fixed	PMC	400V	±20%
C80	.01 μf	fixed	cer	500V	GMV
C100	470μμf	fixed	cer	500V	±10%
C101	470μμf	fixed	cer	500V	±10%
C110	.01 μf	fixed	cer	500V	GMV
C111	.01 μf	fixed	cer	500V	GMV

(MODEL A2 ONLY)

C112	.1 μf	fixed	PT	400V	±20%
C113	.1 μf	fixed	PT	400V	±20%

(MODEL A4 ONLY)

C112	.5 μf	fixed	PT	400V	±20%
C113	1 μf	fixed	PT	400V	±20%
C120	.01 μf	fixed	cer	500V	GMV

(MODEL A2 ONLY)

C121	39μμf	fixed	SM	500V	± 5%
C122	75μμf	fixed	SM	500V	± 5%
C123	220μμf	fixed	SM	500V	± 5%
C124	470μμf	fixed	mica	500V	±10%
C125	2200μμf	fixed	mica	500V	±10%

(MODEL A4 ONLY)

C121	220μμf	fixed	SM	500V	± 5%
C122	470μμf	fixed	mica	500V	±10%
C123	2200μμf	fixed	mica	500V	±10%
C124	.02 μf	fixed	PMC	400V	±10%
C125	.22 μf	fixed	PMC	300V	±10%
C130	4 μf	fixed	EMC	600V	-20+50%
C131	2-40 μf	fixed	EMC	450V	-20+50%
C140	40 μf	fixed	EMC	450V	-20+50%
C141	40 μf	fixed	EMC	450V	-20+50%
C142	40 μf	fixed	EMC	450V	-20+50%
C143	2-.1 μf	fixed	PMC	400V	-10+20%
C170	.25 μf	fixed	PMC	400V	±20%
C190	2ea.01 μf	fixed	cer	500V	GMV

(MODEL A2 ONLY)

C200	.01 μf	fixed	cer	500V	GMV

(MODEL A4 ONLY)

C200	.1 μf	fixed	PT	400V	±20%
C201	.01 μf	fixed	cer	500V	GMV
C202	.01 μf	fixed	cer	500V	GMV

(MODEL A4 ONLY)

C220	1500μμf	fixed	SM	500V	± 5%
C221	.01 μf	fixed	cer	500V	GMV
C222	3300μμf	fixed	mica	500V	±10%
C230	2 μf	fixed	PMC	300V	±20%
C231	47μμf	fixed	cer	500V	±10%
C232	47μμf	fixed	cer	500V	±10%
C240	100μμf	fixed	cer	500V	±10%

(MODEL A4 ONLY)

C400	220μμf	fixed	mica	500V	±10%
C401	2200μμf	fixed	mica	500V	±10%
C402	.022 μf	fixed	PMC	300V	±10%
C403	.22 μf	fixed	PMC	300V	±10%
C404	220μμf	fixed	mica	500V	±10%
C405	2200μμf	fixed	mica	500V	±10%
C406	.022 μf	fixed	PMC	300V	±10%
C407	.22 μf	fixed	PMC	300V	±10%

CHOKES

L80	1mh	fixed	±10%
L130	10 h	fixed	±10%

CONNECTORS

J10	type S0239
J80	type S0239

J110	type S0239
J111	type S0239
J200	type S0239

DIODES

CR80	type 1N34A
CR110	type 1N48
CR140	type 16Y1
CR141	type 16Y1

ELECTRON TUBES

V1	type 12AT7
V2	type 12AT7
V3	type 5964
V4	type 6AL5
V5	type 6AS6
V6	type 6AS6
V7	type 12AU7
V8	type 12AX7
V9	type 12AX7
V10	type 12AT7
V11	type 12AU7
V12	type 12AU7
V13	type 6X4
V14	type 6X4
V15	type 6AS5
V16	type 6AS5
V17	type 6AU6
V18	type 0A2
V19	type 5651
V20	type 12AT7
V21	type 6E5
V22	type 12AT7
V23	type 12AU7
V24	type 6AL5
V25	type 10-4B
V26	type 10-4B

FUSE

F500	2 amp.

LAMPS

DS500	type NE51
DS501	#47

RESISTORS

R10	10K	fixed	comp	½W	±10%
R11	470K	fixed	comp	½W	±10%
R12	390Ω	fixed	comp	½W	±10%
R13	10K	fixed	comp	½W	±10%
R14	10K	fixed	comp	½W	±10%
R20	15K	fixed	comp	1W	±10%
R21	10K	fixed	comp	1W	±10%
R22	220K	fixed	comp	½W	±10%
R23	1meg	fixed	comp	½W	±10%
R24	1K	fixed	comp	1W	±10%
R25	6.8K	fixed	comp	2W	±10%
R26	150K	fixed	comp	½W	±10%
R30	30K	fixed	prec	2W	± 1%
R31	30K	fixed	prec	2W	± 1%
R32	30K	fixed	prec	2W	± 1%
R33	30K	fixed	prec	2W	± 1%
R34	2.2K	fixed	prec	1W	± 1%
R35	22K	fixed	prec	1W	± 1%
R36	22K	fixed	prec	1W	± 1%
R37	10K	fixed	prec	1W	± 1%
R38	4.7K	fixed	comp	2W	±10%
R39	10K	fixed	prec	1W	± 1%
R50	1meg	fixed	prec	½W	± 1%
R51	1.4meg	fixed	prec	½W	± 1%
R52	39K	fixed	comp	2W	±10%
R53	47Ω	fixed	comp	½W	±10%
R54	47Ω	fixed	comp	½W	±10%
R55	47Ω	fixed	comp	½W	±10%
(MODEL A2 ONLY)					
R56	672K	fixed	prec	½W	± 1%
R57	1meg	fixed	prec	½W	± 1%
R58	1meg	fixed	prec	½W	± 1%
(MODEL A4 ONLY)					
R56	Not used				
R57	3-ea. 6.33 meg in series	fixed	prec	1W	± 1%
R60	68K	fixed	comp	2W	±10%
R61	68K	fixed	comp	2W	±10%
R62	68K	fixed	comp	2W	±10%
R63	68K	fixed	comp	2W	±10%
R64	47Ω	fixed	comp	½W	±10%
R65	47Ω	fixed	comp	½W	±10%
R66	47Ω	fixed	comp	½W	±10%

R70	100K	fixed	comp	2W	±10%
R71	100K	fixed	comp	2W	±10%
R72	100K	fixed	comp	2W	±10%
R73	47K	fixed	comp	1W	±10%
R74	750K	fixed	prec	½W	± 1%
R80	10K	fixed	comp	½W	±10%
R81	47K	fixed	comp	½W	±10%
R82	2.2meg	fixed	comp	½W	±10%
R83	50K	var	prec	2W	± 1%
R84	20K	fixed	prec	½W	± 1%
(MODEL A2 ONLY)					
R85	50K	fixed	prec	½W	± 1%
(MODEL A4 ONLY)					
R85	10K	fixed	prec	½W	± 1%
R90	150K	fixed	comp	1W	±10%
R91	1meg	fixed	comp	½W	±10%
R92	350K	fixed	prec	½W	± 1%
R100	2.2meg	fixed	comp	½W	±10%
R101	22K	fixed	comp	2W	±10%
R102	22K	fixed	comp	2W	±10%
R103	100K	fixed	comp	½W	±10%
(MODEL A2 ONLY)					
R104	1.5meg	fixed	comp	½W	±10%
(MODEL A4 ONLY)					
R104	680K	fixed	comp	½W	±10%
R110	68K	fixed	comp	2W	±10%
R111	15K	fixed	comp	2W	±10%
R112	470Ω	fixed	comp	½W	±10%
R113	2.2meg	fixed	comp	½W	±10%
R114	4.7K	fixed	comp	2W	±10%
R120	220K	fixed	comp	½W	±10%
R121	10K	fixed	comp	2W	±10%
R122	22K	fixed	comp	½W	±10%
R123	25K	var	comp	2W	±20%
R124	4.7K	fixed	comp	2W	±10%
R125	4.7meg	fixed	comp	½W	±10%
R126	4.7K	fixed	comp	2W	±10%
R130	1meg	fixed	comp	½W	±10%
R131	1meg	fixed	prec	½W	± 1%
R140	1250Ω	fixed	WW	10W	±10%
R141	1K	fixed	comp	2W	±10%
R142	1K	fixed	comp	2W	±10%
R143	1K	fixed	comp	2W	±10%
R150	4.5K	fixed	WW	25W	±10%
R151	47Ω	fixed	comp	½W	±10%
R152	47Ω	fixed	comp	½W	±10%

R160	47Ω	fixed	comp	½W	±10%
R161	47Ω	fixed	comp	½W	±10%
R170	400K	fixed	prec	½W	± 1%
R171	100K	fixed	prec	½W	± 1%
R172	100K	fixed	comp	½W	±10%
R173	150K	fixed	comp	½W	±10%
R180	15K	fixed	comp	1W	±10%
R190	15K	fixed	comp	½W	± 1%
R200	1.5meg	fixed	comp	½W	±10%
R201	250K	var	comp	2W	±20%
R202	820K	fixed	comp	½W	±10%
R203	330K	fixed	comp	½W	±10%
R204	22meg	fixed	comp	½W	±10%
R205	22meg	fixed	comp	½W	±10%
R206	22meg	fixed	comp	½W	±10%
R207	22meg	fixed	comp	½W	±10%
R208	470K	fixed	comp	½W	±10%
R209	3.3meg	fixed	comp	½W	±10%
R210	1meg	fixed	comp	½W	±10%
(MODEL A4 ONLY)					
R220	3.3K	fixed	comp	½W	±10%
R221	270K	fixed	comp	½W	±10%
R222	15K	fixed	comp	½W	±10%
R223	270K	fixed	comp	½W	±10%
R224	15K	fixed	comp	½W	±10%
R225	470Ω	fixed	comp	½W	±10%
R230	10K	fixed	prec	½W	± 1%
R231	10K	fixed	prec	½W	± 1%
R232	47K	fixed	comp	½W	±10%
R233	47K	fixed	comp	½W	±10%
R234	17meg	fixed	prec	½W	± 1%
R235	17meg	fixed	prec	½W	± 1%
R236	50K	var	comp	2W	±20%
R240	150K	fixed	comp	½W	±10%
R241	220K	fixed	comp	½W	±10%
R300	15K	var	WW	2W	±20%
R301	15K	var	WW	2W	±20%
R302	15K	var	WW	2W	±20%
R303	15K	var	WW	2W	±20%
R304	15K	var	WW	2W	±20%
R305	15K	var	WW	2W	±20%
R306	15K	var	WW	2W	±20%
R307	15K	var	WW	2W	±20%
R308	15K	var	WW	2W	±20%
R309	15K	var	WW	2W	±20%

(MODEL A2 ONLY)

R310	20K	fixed	prec	1/2W	± 1%
R311	12K	fixed	prec	1/2W	± 1%
R312	56K	fixed	prec	1/2W	± 1%

(MODEL A4 ONLY)

R310	Not Used
R311	Not Used
R312	Not Used

R400	100K	var	comp	2W	±20%
R401	100K	var	comp	2W	±20%
R402	100K	var	comp	2W	±20%
R403	100K	var	comp	2W	±20%
R404	10K	var	comp	2W	±20%
R405	10K	var	comp	2W	±20%
R406	10K	var	comp	2W	±20%
R407	10K	var	comp	2W	±20%

R500	330K	fixed	comp	1/2W	±10%
R501	2.5Ω	fixed	WW	25W	±10%

SWITCHES

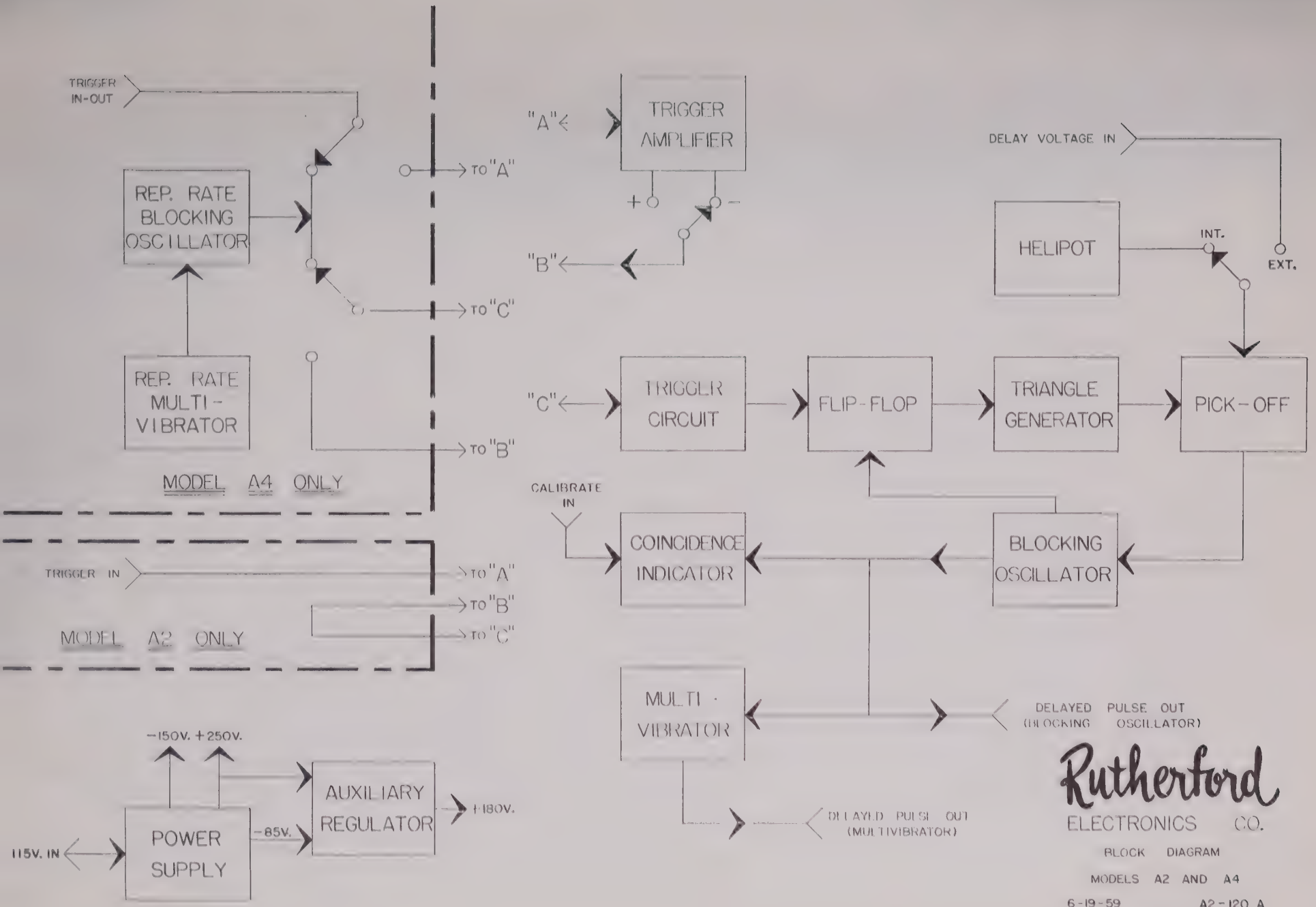
S10	Toggle
S80	Toggle

(MODEL A4 ONLY)

S230	Rotary
S300	Rotary
S500	Toggle
S501	Thermostat

TRANSFORMERS

T110	1μsec. (Nominal), 1:1 Pulse Transformer		
T220	1μsec. (Nominal), 1:1 Pulse Transformer		
T500	A2-E-630	Fil. Xfmr.	Rutherford



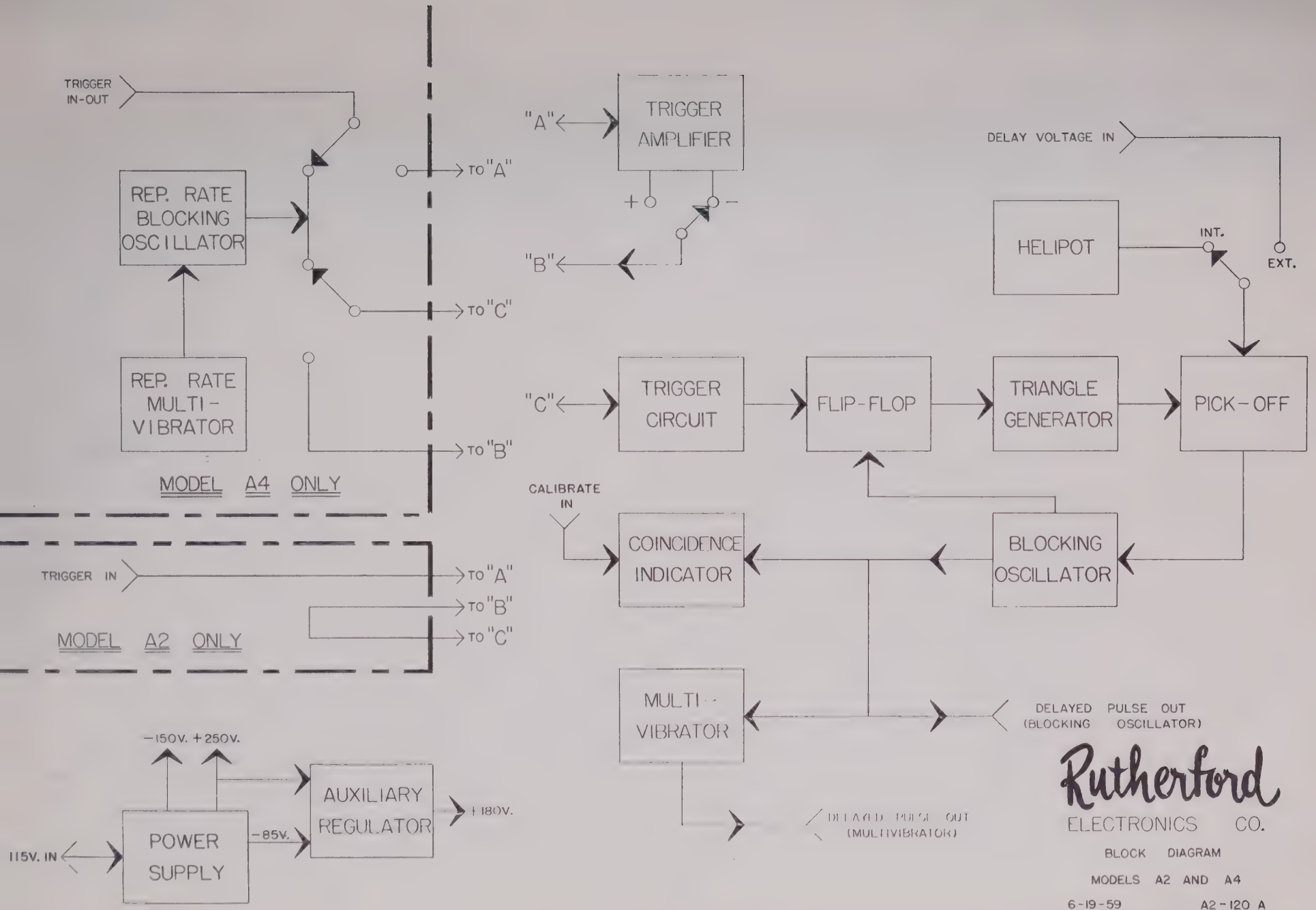
Rutherford ELECTRONICS CO.

BLOCK DIAGRAM

MODELS A2 AND A4

6-19-59 A2-120 A

DR BY Wcm APP BY



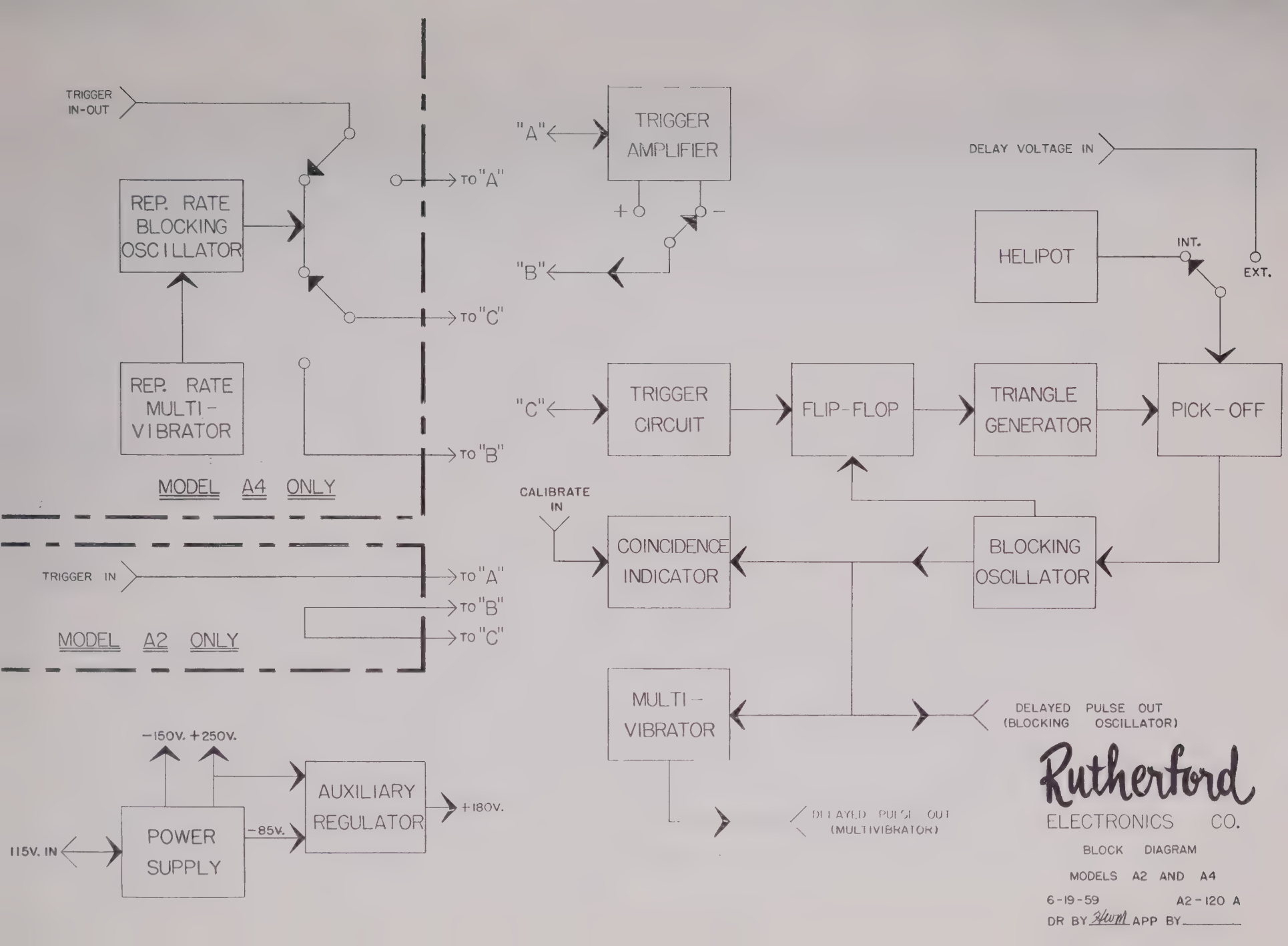
Rutherford
ELECTRONICS CO.

BLOCK DIAGRAM

MODELS A2 AND A4

6-19-59 A2-120 A

DR BY [illegible] APP BY _____



Rutherford
ELECTRONICS CO.

BLOCK DIAGRAM

MODELS A2 AND A4

6-19-59 A2-120 A

DR BY [illegible] APP BY _____

NOTE: UNLESS OTHERWISE SPECIFIED,

1. ALL RESISTORS ARE 1/2 WATT, ±10%.
2. ALL CAPACITOR VALUES LESS THAN ONE ARE IN MICRO-FARADS, THOSE GREATER THAN ONE ARE IN MICROMICRO-FARADS.
3. COMPONENT VALUES NOT SHOWN ON THE SCHEMATIC INDICATE A DIFFERENCE IN THE VALUE BETWEEN THE A2 AND A4. THESE VALUES MAY BE FOUND IN THE CHART BELOW.

COMPONENT	MODEL A2	MODEL A4
C60	3-12	NOT USED
C61	15	100
C62	240	1000
C63	1000	.01
C64	.01	.1
C65	.1	2 FA. .5, IN PARALLEL
C112	.1	.5
C113	.1	1 MF
C121	39	220
C122	75	470
C123	220	2200
C124	470	.02
C125	2200	.22
C200	.01	.1
R56	672K, 1%	0
R57	1 MEG, 1%	3 EA. 6.33 MEG. 1%, IN SERIES
R58	1 MEG, 1%	0
R85	50K, 1%	10K, 1%
R104	1.5 MEG	680K
R310	20K	0
R311	12K	0
R312	56K, 1%	0

APP.	REV.	DATE	C.O. NO.	BY
	H	2.10.61	345	V.S.
	G	10.26.60	299	V.S.
	F	8-20-59	241	V.S.
	E	6-17-59	236	DWM
	D	4-4-58	1418142	DULEN
	C	5-27-57	89 & 90	DWM
	B			
	A			

THIS SECTION FOUND ONLY IN THE MODEL A4

THIS SECTION FOUND ONLY IN THE MODEL A2

MODEL A2 ONLY

MODEL A4 ONLY

MODEL A2 ONLY

DELAYED PULSE OUT (BLOCKING OSCILLATOR)

DELAYED PULSE OUT (MULTIVIBRATOR)

CALIBRATE INPUT

DELAY VOLTAGE IN

TRIGGER POLARITY

TRIGGER IN-OUT

Rutherford ELECTRONICS CO.

SCHEMATIC DIAGRAM

MODELS A2 AND A4

6/13/59 A2-100H

DR. BY DWM APP. BY

Rutherford ELECTRONICS CO.
8944 Lindblade Street • Culver City, California
Telephone: Upton 0-7393 • TWX CVR-CY-4133

ACCESSORY ASSEMBLIES

PRINTED IN U.S.A.
AUGUST 1, 1960

Rutherford accessories are precisely designed to enhance greater efficiency and performance, ease of operation for use in pulse instrumentation

PART NO.	DASH NO.	NAME	DESCRIPTION	PRICE
J001	–1	Extension Cable, Coax. 185 ohms (RG 114/u) Type C Connector, Both Ends	6 in. long	$17.50
	–2		10 in. long	17.50
	–3		20 in. long	17.50
	–4		24 in. long	17.50
	–5		48 in. long	19.50
	–6		96 in. long	19.50
J002	–1	Extension Cable, Coax. 185 ohms (RG 114/u) Type C Connector, One end, Open Other End	24 in. long	10.00
	–2		48 in. long	10.00
	–3		60 in. long	10.50
	–4		96 in. long	10.50
J003	–1	Extension Cable, Coax. 50 ohms (RG 58/u) Type BNC Connector, Both Ends	12 in. long	5.00
	–2		24 in. long	5.00
	–3		48 in. long	5.50
	–4		96 in. long	5.50
J004	–1	Extension Cable, Coax. 50 ohms (RG 58/u) Type BNC Connector, One End, Open Other End	12 in. long	2.50
	–2		24 in. long	2.50
	–3		48 in. long	3.50
	–4		96 in. long	3.50
J005	–1	Extension Cable, Coax. 50 ohms (RG 58/u) Type N Connector, Both Ends	24 in. long	9.50
	–2		48 in. long	10.00
	–3		96 in. long	10.00
J006	–1	Extension Cable, Coax. 50 ohms (RG 58/u) Type N Connector, One End, Open Other End	24 in. long	5.00
	–2		48 in. long	5.50
	–3		96 in. long	5.50
J007	–1	Extension Cable, Coax. 50 ohms (RG 58/u) Type UHF Connector, Both Ends	12 in. long	4.50
	–2		24 in. long	4.50
	–3		48 in. long	5.00
	–4		96 in. long	5.00
J008	–1	Extension Cable, Coax. 50 ohms (RG 58/u) Type UHF Connector, One End, Open Other End	12 in. long	2.50
	–2		24 in. long	2.50
	–3		48 in. long	3.00
	–4		96 in. long	3.00
J009	–1	Extension Cable, Coax. 93 ohms (RG 62/u) Type BNC Connector, Both Ends	12 in. long	9.00
	–2		24 in. long	9.00
	–3		48 in. long	9.50
	–4		96 in. long	9.50
J010	–1	Extension Cable, Coax. 93 ohms (RG 62/u) Type BNC Connector, One End, Open Other End	12 in. long	4.50
	–2		24 in. long	4.50
	–3		48 in. long	5.50
	–4		96 in. long	5.50

PART NO.	DASH NO.	NAME	DESCRIPTION	PRICE
J011	–1	Extension Cable, Coax. 93 ohms (RG 62/u) Type UHF Connector, Both Ends	12 in. long	4.50
	–2		24 in. long	4.50
	–3		48 in. long	5.50
	–4		96 in. long	5.50
J012	–1	Extension Cable, Coax. 93 ohms (RG 62/u) Type UHF Connector, One End, Open Other End	12 in. long	2.50
	–2		24 in. long	2.50
	–3		48 in. long	3.50
	–4		96 in. long	3.50
J014		Extension Cable, 16 Wire, Amphenol 26-4100-16P Plug, One End, 26-4200-16S Socket, Other End	40 in long. Extension Cable to be used with Model B3 and Model B5 Systems	15.00
J015		Extension Cable, 11 wire, Amphenol #86 PM11 Plug, One End, #78 PF11 Socket, Other End	24 in. long. Extension Cable to be used with Model B2 and B2A Pulse Generators	9.00
J017	–1	Adapter	Adapter, Banana Plug to Type BNC Coax. Connector, Non-Locking	6.50
	–2	Adapter	Adapter, Banana Plug to Type BNC Coax. Connector, Lock-on Type	7.50
	–3	Adapter	Adapter, Banana Plug to Type UHF Coax. Connector, Lock-on Type	7.50
	–4	BNC Binding Post Adapter	Can be used to adapt the Single Shot Pulse Generator to the B-5A 10 MC Pulse Generator.	7.50
J018		"One-Shot" Pulse Generator	"One-Shot" Push Button Actuated Pulse Generator. Suitable for Single Pulse Operation of Model B7 Pulse Generator. 18 Volt Pulse into 470 ohms Mounts in Standard Banana Jacks	47.50
J019	–1	Air Filter End Cover	Replaces Intake End Cover on Model B7 Pulse Generator to Prevent Excessive Dust from Entering Instrument. Filter Removable for Cleaning or Replacement	18.00
	–2	Air Filter End Cover	Same as –1, Except for Model B7B Pulse Generator	18.00
J013		Mixer Assembly	"Two Input" Mixer Assembly for B3 System	55.00
J032	–1	Mixer Assembly	"Two Input" Mixer Assembly for Model B7 or B7B. Maximum Input Power Each, Input 30 Watts Average. Impedance 50 ohms	45.00
	–2	Mixer Assembly	"Three Input" Mixer Assembly for Model B7 or B7B. Maximum Input Power Each, Input 30 Watts Average. Impedance 50 ohms	60.00
	–3	Mixer Assembly	"Four Input" Mixer Assembly for Model B7 or B7B. Maximum Input Power Each, Input 30 Watts Average. Impedance 50 ohms	75.00

INSTRUCTION MANUALS

NOTE: Serial Numbers of Instrument Must Be Included When Reordering Instruction Manuals

PART NO.	DASH NO.	NAME	DESCRIPTION	PRICE
J020		Instruction Manual	For Model A2 or Model A4 Time Delay Generator	5.00
J021	–1*	Instruction Manual	For Model B2 Pulse Generator	7.50
	–2		For Model B2A Pulse Generator	7.50
J022*	–1	Instruction Manual	For Model B3 Pulse Generator	7.50
	–2		For Model B3-2 Pulse Generator	10.00
	–3		For Model B3-2A Pulse Generator	10.00
	–4		For Model B3-3 Pulse Generator	10.00
	–5		For Model B3-4 Pulse Generator	10.00
J023*		Instruction Manual	For Model B4 Time Measuring System	7.50
J024	–1*	Instruction Manual	For Model B5 Pulse Generator	7.50
	–2		For Model B5A Pulse Generator	7.50
	–3		For Model B5-2 Pulse Generator	10.00
J025	–1*	Instruction Manual	For Model B7 Pulse Generator	5.00
	–2		For Model B7B Pulse Generator	5.00
J026*		Instruction Manual	For Model D2 Calibrator	7.50
J027*		Instruction Manual	For Model G1 Pulse and Sq. Wave Generator	7.50
J028		Instruction Manual	For Model J018 "One-Shot" Pulse Generator	3.00

*Indicates Instrument No Longer In Production, But Manuals For Existing Instruments Available

INSTRUMENT MODIFICATION

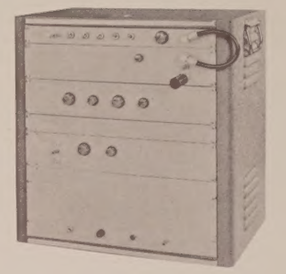
PART NO.	DASH NO.	NAME	DESCRIPTION	PRICE
J029	–1		Modifies the Model B2A to Provide for External Delay and Width Modulation	115.00
	–2		Modifies the Model B2A to Provide for External Delay Modulation	65.00
J030			Modifies Model B2 to Configuration and Specification of the Model B2A	400.00
J031			Modifies Model A2 or Model A4 to Incorporate Special Delay Range Per Customer Requirement	60.00
J033			Modifies Model B5 to Model B5-A	1,000.00
J034			Modifies Model B5 to Model B5-2 Double Pulse Generator	3,073.00
J035			Modifies Model B5-A to Model B5-2 Double Pulse Generator	2,080.00
J036			Delay Cable Model B5-2	325.00

THE ACCESSORIES ARE DESIGNED TO COMPLEMENT *Rutherford* PULSE INSTRUMENTATION

NEW MODEL B7-B HIGH REPETITION RATE PULSE GENERATOR AT LOW COST, HIGH PERFORMANCE and WIDE VERSATILITY

50 volts into 50 ohms at 30% duty factor . . . rep. rate to 2 mc . . . widths .05 μs to 10,000 μs . . . delays to 10,000 μs . . .

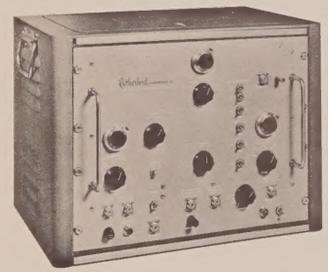
Low Budget Price . . . **$720.00**



10 MEGACYCLE PULSE GENERATOR MODEL B5-A

Featuring . . . high repetition rate with no greater than 8 millimicroseconds rise and fall time operating from 1 cps to 10 megacycles.

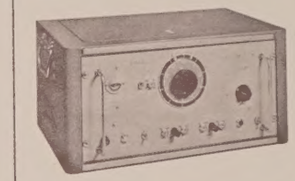
Price: **$2,400.00**



MODEL B2-A

A general purpose instrument which produces pulses of accurately controlled widths, amplitude and time delay at low impedance. Internal oscillator gives repetition rates from 10 cycles to 100 kc. Pulse widths from .08 μs to 1,000 μs.

Price: **$1,280.00**

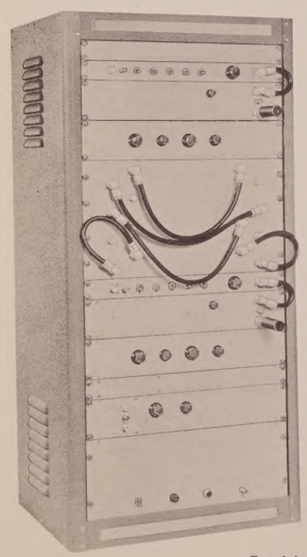


TWO TIME DELAY GENERATORS

Model A-2 **Model A-4**

Feature: Low jitter. Linear scales. Small repetition rate effects. External connector provided for delay voltage so that unit may be externally time modulated. Easily read dial controls.

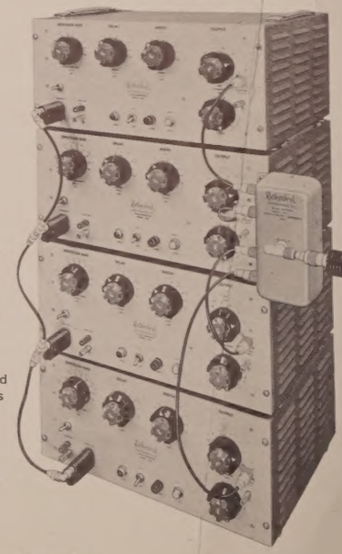
Price: Model A-2 **$750.00** Model A-4 **$875.00**



HIGH SPEED 10 MEGACYCLE DOUBLE PULSE GENERATOR MODEL B5-2

Both pulse trains are derived from one single oscillator. Its output pulses are adjustable in widths from 20 mμs to 12.5 μs with rise and fall time no greater than 8 mμs. Maximum pulse width is restricted to about 20% of the pulse to pulse spacing. (Duty cycle .20 or less). Continuously variable repetition rate, pulse width and pulse delay permit the study of high speed switching circuits.

Price: **$3.975.00**



MULTI-PULSE Rutherford HIGH REPETITION RATE MULTI-PULSING SYSTEM at low cost!

4 MODEL B7-B with the use of a MIXING NETWORK produces 4 INDIVIDUAL PULSES of various specifications. The stacked units may be placed in a 19" rack type cabinet. Each of the four B7-B models can be disassembled and returned to laboratories for use as individual pulse generators.

Price: **$720.00** each,

MIXER ASSEMBLY - **$75.00**

All prices F. O. B. Culver City, California

For detailed specifications on Rutherford pulse instrumentation write for complete bulletin.

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TWX Kensington, Md., 247

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G. E. MOXON ELECTRONICS CO.
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Tel: Greenfield 3-4169

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Rutherford ELECTRONICS CO.

8944 Lindblade Street Culver City, California Telephone: UPton 0-7393 TWX-CVR-CY-4133

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PART NUMBERS FOR TERMINATIONS

PART NO.	CONNECTORS	IMPEDANCE	WATTAGE	PRICE	PART NO.	CONNECTORS	IMPEDANCE	WATTAGE	PRICE
K001-1	N (Male)	50 ohms	2*	35.00	K002-11	C (Male)	50 ohms	5*	40.00
K001-2	N (Male)	75 ohms	2*	37.50	K002-12	C (Male)	75 ohms	5*	42.00
K001-3	N (Male	93 ohms	2*	37.50	K002-13	C (Male)	93 ohms	5*	42.00
K001-4	N (Male)	125 ohms	2*	39.00	K002-14	C (Male)	125 ohms	5*	45.00
K001-5	N (Male)	185 ohms	2*	39.00	K002-15	C (Male)	185 ohms	5*	45.00
K001-6	N (Female)	50 ohms	2*	35.00	K002-16	C (Female)	50 ohms	5*	40.00
K001-7	N (Female)	75 ohms	2*	37.50	K002-17	C (Female)	75 ohms	5*	42.00
K001-8	N (Female)	93 ohms	2*	37.50	K002-18	C (Female)	93 ohms	5*	42.00
K001-9	N (Female)	125 ohms	2*	39.00	K002-19	C (Female)	125 ohms	5*	45.00
K001-10	N (Female)	185 ohms	2*	39.00	K002-20	C (Female)	185 ohms	5*	45.00
K001-11	C (Male)	50 ohms	2*	35.00	K003-1	N (Male)	50 ohms	10*	42.50
K001-12	C (Male)	75 ohms	2*	37.50	K003-2	N (Male)	75 ohms	10*	45.00
K001-13	C (Male)	93 ohms	2*	37.50	K003-3	N (Male)	93 ohms	10*	45.00
K001-14	C (Male)	125 ohms	2*	39.00	K003-4	N (Male)	125 ohms	10*	48.00
K001-15	C (Male)	185 ohms	2*	39.00	K003-5	N (Male)	185 ohms	10*	48.00
K001-16	C (Female)	50 ohms	2*	35.00	K003-6	N (Female)	50 ohms	10*	42.50
K001-17	C (Female)	75 ohms	2*	37.50	K003-7	N (Female)	75 ohms	10*	45.00
K001-18	C (Female)	93 ohms	2*	37.50	K003-8	N (Female)	93 ohms	10*	45.00
K001-19	C (Female)	125 ohms	2*	39.00	K003-9	N (Female)	125 ohms	10*	48.00
K001-20	C (Female)	185 ohms	2*	39.00	K003-10	N (Female)	185 ohms	10*	48.00
K002-1	N (Male)	50 ohms	5*	40.00	K003-11	C (Male)	50 ohms	10*	42.50
K002-2	N (Male)	75 ohms	5*	42.00	K003-12	C (Male)	75 ohms	10*	45.00
K002-3	N (Male)	93 ohms	5*	42.00	K003-13	C (Male)	93 ohms	10*	45.00
K002-4	N (Male)	125 ohms	5*	45.00	K003-14	C (Male)	125 ohms	10*	48.00
K002-5	N (Male)	185 ohms	5*	45.00	K003-15	C (Male)	185 ohms	10*	48.00
K002-6	N (Female)	50 ohms	5*	40.00	K003-16	C (Female)	50 ohms	10*	42.50
K002-7	N (Female)	75 ohms	5*	42.00	K003-17	C (Female)	75 ohms	10*	45.00
K002-8	N (Female)	93 ohms	5*	42.00	K003-18	C (Female)	93 ohms	10*	45.00
K002-9	N (Female)	125 ohms	5*	45.00	K003-19	C (Female)	125 ohms	10*	48.00
K002-10	N (Female)	185 ohms	5*	45.00	K003-20	C (Female)	185 ohms	10*	48.00

CONNECTORS: N (Male) = #UG 21D/U
N (Female) = #UG 23D/U
C (Male) = #UG 573A/U
C (Female) = #UG 572/U

*1000 LFM per minute

ALL DATA SUBJECT TO CHANGE WITHOUT NOTICE

PART NUMBERS FOR ATTENUATORS

PART NO.	CONNECTORS	ATTENUATORS (DB)	WATTAGE	PRICE
M001-1	N	1	4	30.00
M001-2	N	2	4	30.00
M001-3	N	5	4	30.00
M001-4	N	10	2	30.00
M001-5	N	20	1	40.00
M001-6	C	1	4	35.00
M001-7	C	2	4	35.00
M001-8	C	5	4	35.00
M001-9	C	10	2	35.00
M001-10	C	20	1	45.00
M002-1	N	1	15	45.00
M002-2	N	2	15	45.00
M002-3	N	5	10	50.00
M002-4	N	10	10	50.00
M002-5	N	20	5	60.00
M002-6	C	1	15	50.00
M002-7	C	2	15	50.00
M002-8	C	5	10	55.00
M002-9	C	10	10	55.00
M002-10	C	20	5	65.00

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